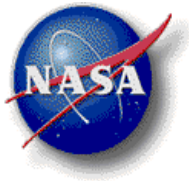


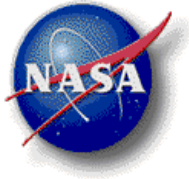
Wireless Technologies In Support of ISS Experimentation and Operations

Presenter: Raymond Wagner
June 26, 2012

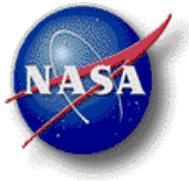


Outline

- Wireless Communications
 - Internal
 - External
- RFID (Radio Frequency Identification)
 - Existing and R&D
- Wireless Sensor Networks
 - Existing and R&D
- Ultra-Wide Band (UWB)
 - R&D

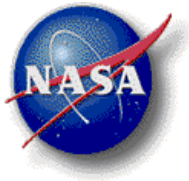


WIRELESS COMMUNICATIONS



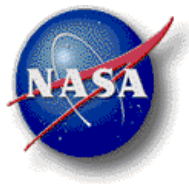
Internal Wireless LAN

- Wireless access points provide 802.11g services on the Joint Station LAN (JSL) in support of Operations, but not Payloads
- Extensions to 802.11n are in work
 - In addition for use in Operations, this upgrade will provide network access for Payloads in the EXPRESS (Expedite the PRocessing of Experiments to the Space Station) racks
 - EXPRESS rack is a standardized payload rack system that transports, stores, and supports experiments aboard ISS

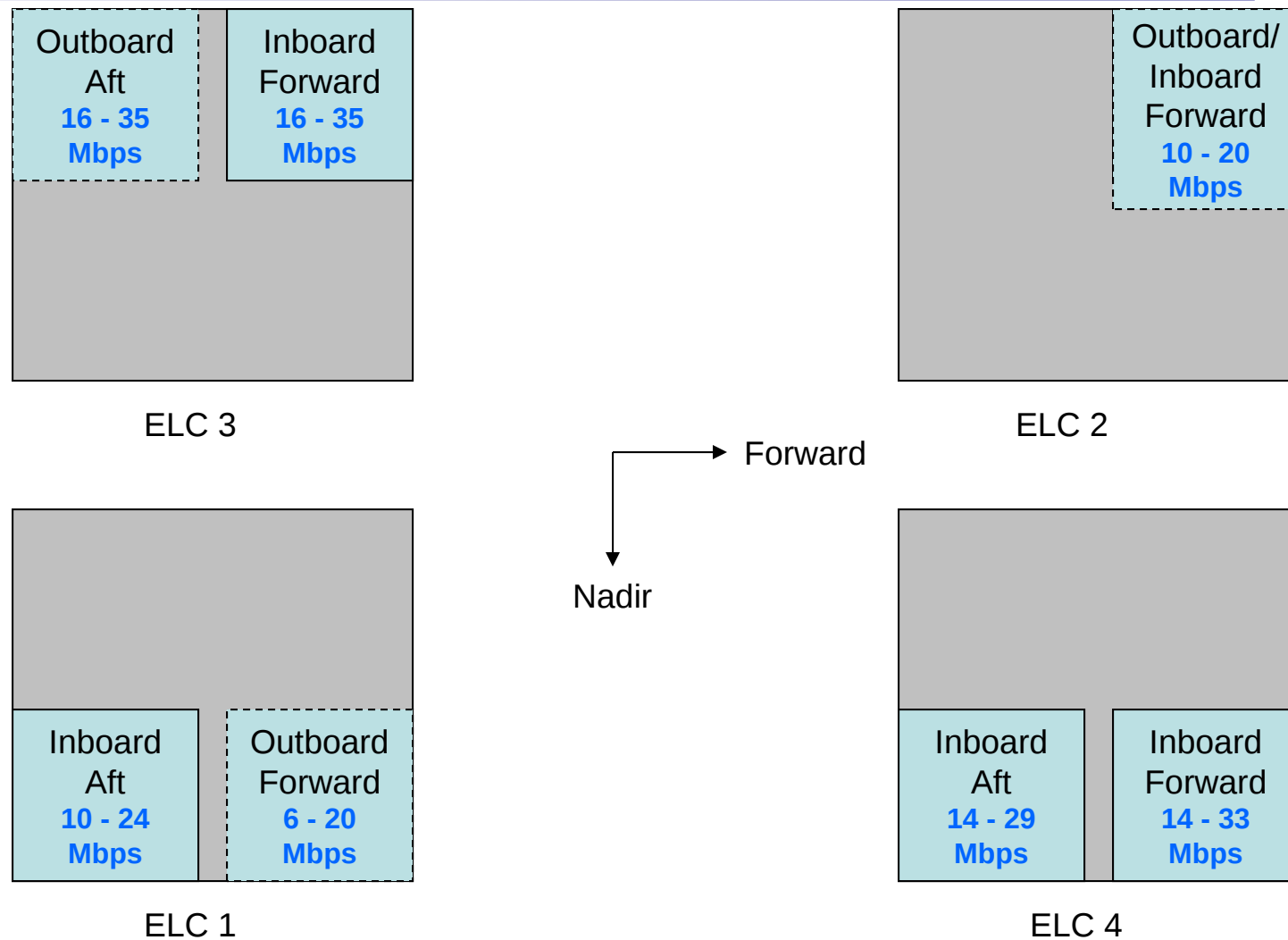


External Wireless Communications

- Provision of external wireless communications has been initiated
- Initial objective is to provide 802.11n services to payloads on the Express Logistics Carriers (ELC)
- Expected operational date: **X WAP expected delivery: 12/2012**
- Expected data rates: 6-35 Mbps
- It is possible that sufficient experimenter demand for extended coverage could result in addition of 802.11n bridges



TCP Data Rate for ELC Payload Sites Myers Antenna

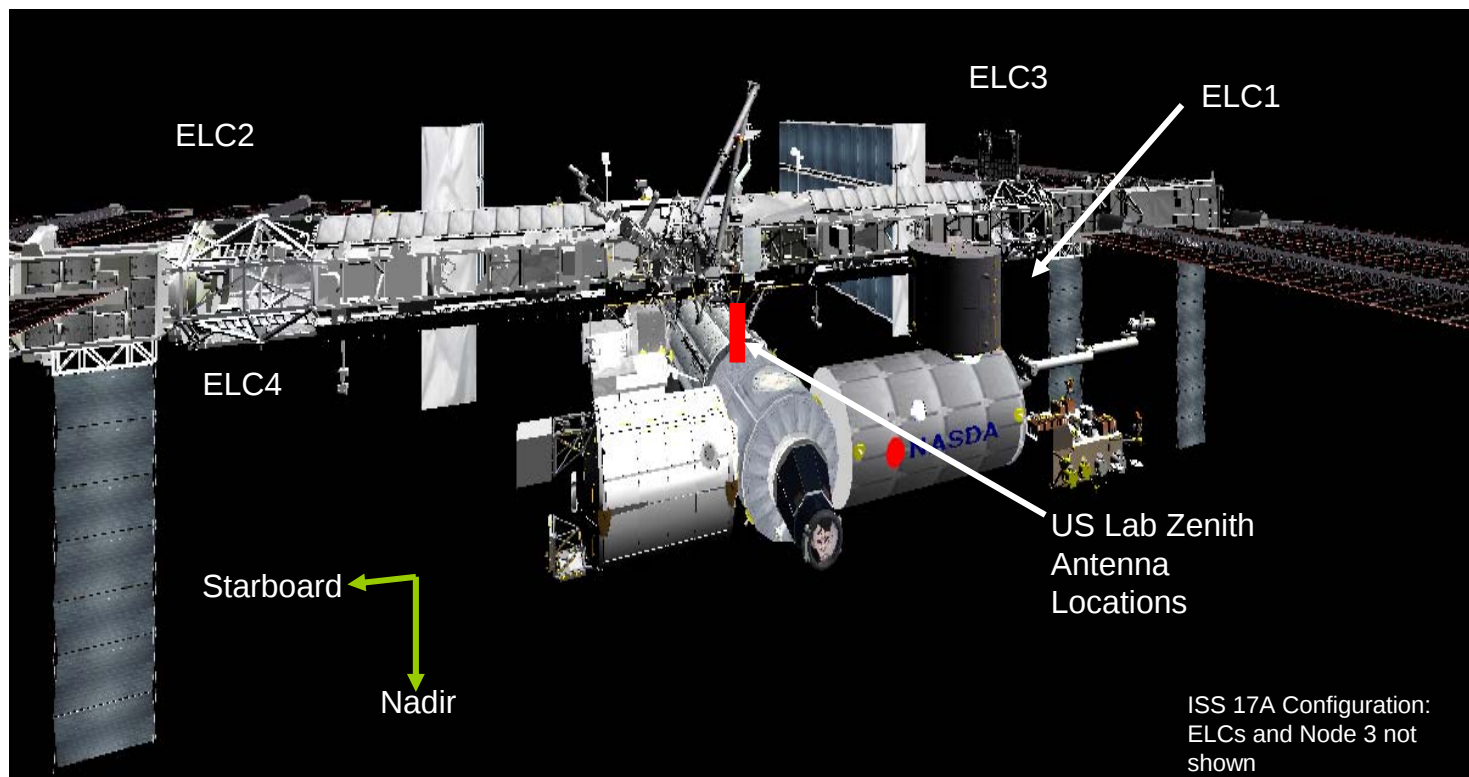
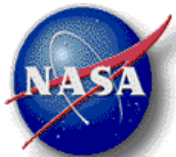


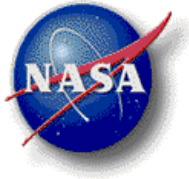
P3 Truss ELCs

EV6/ESCG

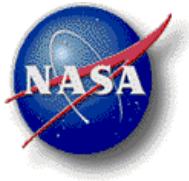
S3 Truss ELCs

03/31/2011



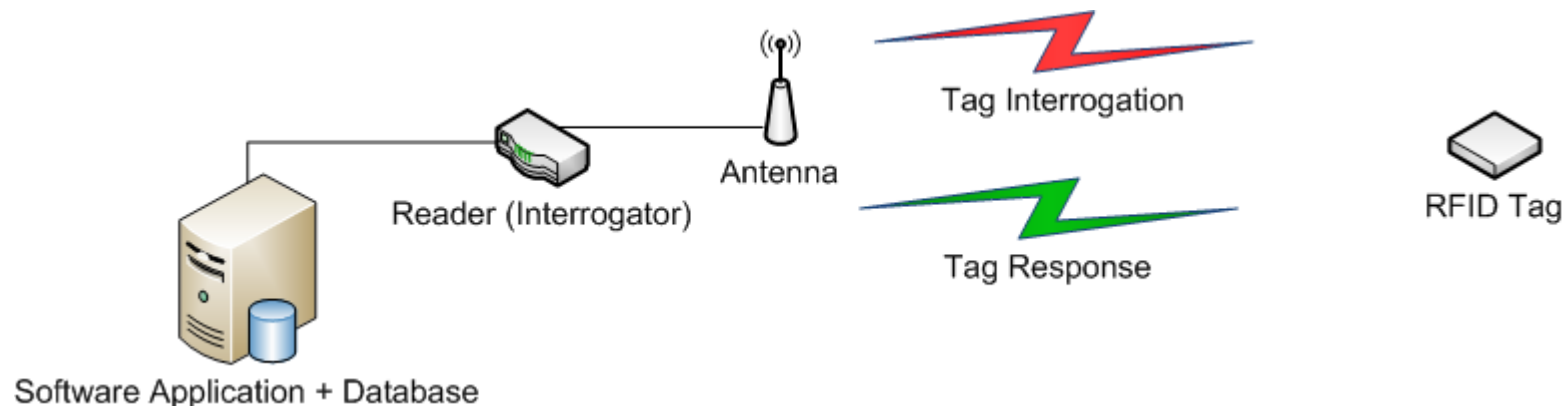


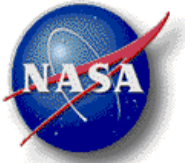
RADIO FREQUENCY IDENTIFICATIONS (RFID)



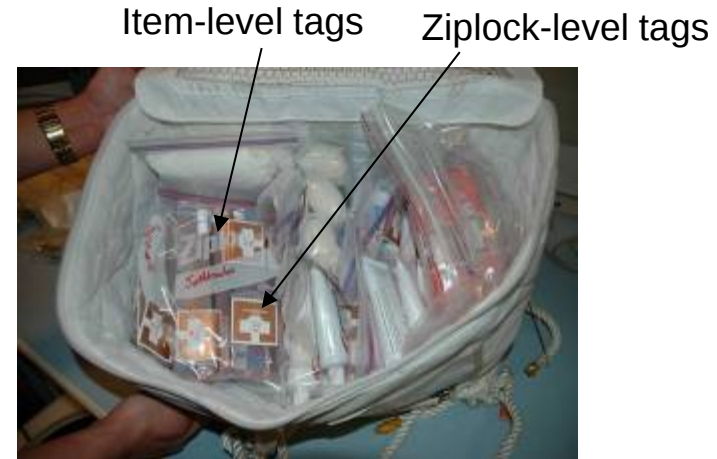
Components of an RFID System

- Basic RFID system (IC-based):
 - An **interrogator** (reader) with antenna
 - A **transponder** (RF tag) containing an antenna and IC
- Consultative Committee for Space Data Standards recommended practice for RFID for Inventory Management: EPC Class 1, Generation 2 RFID Standard: UHF 860 – 960 MHz
 - Passive tag, interrogator-talks-first

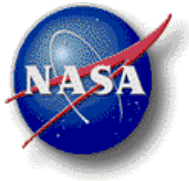




RFID Technology Infusion Into ISS



- Background
 - RFID-enabled inventory processes can reduce crew time for audits thus increasing time for science
 - RFID handheld readers and tags are currently on orbit to supplement the optical barcode function and facilitate searches for missing items
 - Currently, about 3,000 items on ISS are RFID-tagged

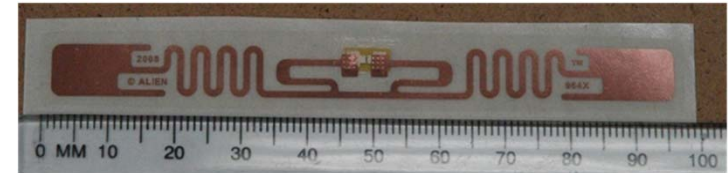


Current RFID Infrastructure

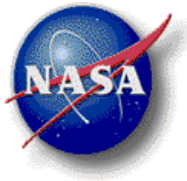


Omni-ID "Prox" tag for conductive items

Alien "Squiggle" Tag for non-conductive items

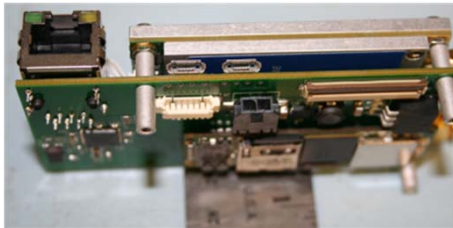


- Handheld RFID/barcode reader is current basis for on-board RFID technology
 - Two primary RFID functions:
 - Crew-assisted Cargo Transfer Bag (CTB) audits
 - 20 seconds compared to 2 minutes per CTB audit
 - Translation of CTB to tag-free area for scan increases cost to several minutes per CTB
 - Search for missing items – audible rate increases with proximity

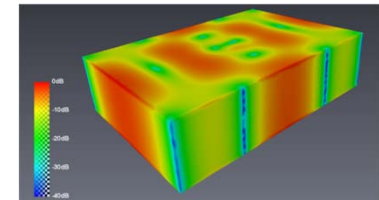
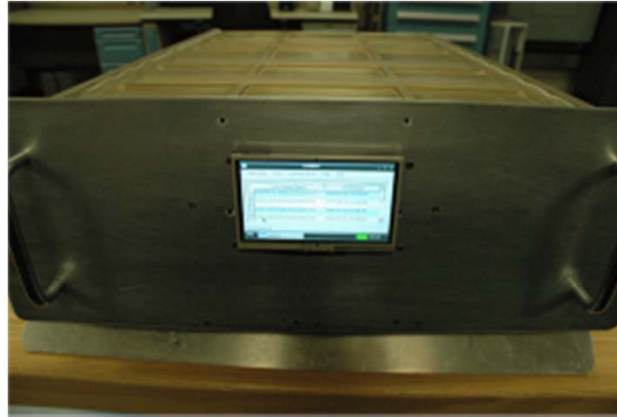


RFID Technologies for IM Automation

Embedded RFID Reader
(EMBER)



EMBER on ISIS Drawer

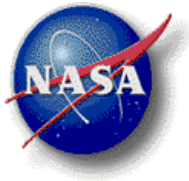


CEM Model for
RFID Enclosure

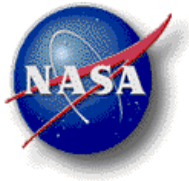
Zero-g Stowage Rack (ZSR)



RFID Enabled
Waste Receptacle

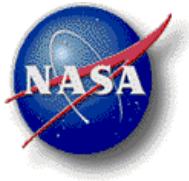


WIRELESS SENSOR NETWORKS



Current Wireless Sensor Networks

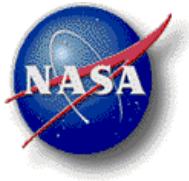
- (Addressed in another talk):
 - Internal Wireless Instrumentation System (IWIS)
 - External Wireless Instrumentation System (EWIS)
 - For structural health monitoring
 - Covered in separate presentation



Proposed Wireless Sensor Networks

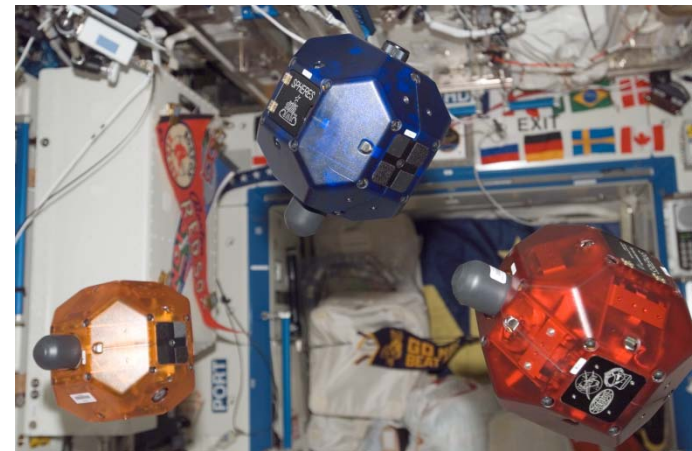
- Architecture emphasizing **infrastructure** over **application**
 - multiple applications join single, standards-based network
 - applications cooperate rather than compete
- Follows CCSDS Wireless Working Group (WWG) recommended practices (low-datarate)
 - IEEE 802.15.4 for contention-free access
 - ISA100.11a for contention-based access
- CCSDS WWG recommendations for high-datarate in works
 - modular hardware for rapid prototyping
 - Smart Sensor Inter-Agency Reference Testbench (SSIART) proposed for evaluation environment

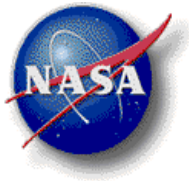




Proposed Ultra-Wide Band R&D

- **Key Features**
 - Immunity to interference from narrow band RF systems due to ultra-wide bandwidth
 - Low impact on other RF systems due to extremely low power spectral densities
 - Capable of precise tracking due to fine time resolution (picoseconds)
 - 3-D localization of EVA/IVA assets to aid in telerobotic operations i.e. SPHERES, R-2





Conclusions

- Wireless communications systems are either new or are in the process of being upgraded
 - External wireless communications (new)
 - Internal wireless communications for Payloads (new)
 - Internal wireless communications for Operations (upgrade)
- New RFID capability might be useful to Experimenters in two areas
 - Inventory tracking for equipment, samples, consumables, etc.
 - Localization, robotic object recognition
- Proposed wireless sensor network capabilities might provide infrastructure for highly reliable data transport in challenging environment and high precision localization of assets or robots